HUME DAM

Nomination for a

NATIONAL ENGINEERING LANDMARK

Institution of Engineers, Australia

June 2002

CONTENTS

Nomination Form

Administrator
Engineering Heritage Australia
The Institution of Engineers, Australia
Engineering House
11 National Circuit
BARTON ACT 2600

THE AUSTRALIAN HISTORIC ENGINEERING PLAQUING PROGRAM

Nominating Body: Engineering Heritage Committee, Sydney Division, The Institution of Engineers, Australia

The following work is nominated for a:

* National Engineering Landmark;

Name of work: Hume Dam

Location, including address and map grid reference if a fixed work: 16 km east of Albury on the Murray River

Owner: Murray-Darling Basin Commission (formerly River Murray Commission)

Operator: Department of Land and Water Conservation NSW

The owner has been advised of this nomination, and a letter of agreement is attached.

Access to site: By road from the city of Albury

....
Chair of Nominating Committee

Date: ....3/7/02..........

Brief history of Hume Dam

The origins of Hume Dam go back to the late nineteenth century as interest in irrigated agriculture developed and the need for a reliable water supply along the Murray River was recognised.

At the Corowa Water Conference in 1902 shortly after federation, the need for a major storage on the upper Murray was agreed, but it was not until 1919 that construction of Hume Dam commenced. However its capacity was not decided on until 1926.

The work began with the concrete gravity section, designed and constructed by New South Wales and the main earthen embankment designed and constructed by Victoria. The two States set up separate organisations, each with quite different terms and conditions of employment, and established individual construction camps on their side of the river. .

Financial problems in the Great Depression of the 1930s caused governments to limit construction without restricting the ultimate design capacity. Construction was substantially completed in 1936.

After the Second World War various soldier settlement areas were developed for irrigation in South Australia, Victoria and New South Wares, which increased demand for the waters of the Murray. In 1950 work began on completion of the spillway and installation of spillway gates to achieve the original design capacity of 2,460 gigalitres.

Before these works were completed it was decided in 1954 to further enlarge the capacity of Hume Dam to 3,038 GL, to regulate the additional flows to the Murray that were to be diverted from the Snowy Mountains Scheme. Whilst the crest level of the main embankment was not increased, a concrete parapet wall was added to protect the structure from over-topping wave action. A range of other works was also undertaken. In addition, the town of Tallangatta was relocated above storage level and the Bethanga Bridge was raised.

Over the past 60 years Hume Dam has endured a series of remedial works in addition to the enlargement works of the 1950s. Following its first filling in 1939-40, the effects of reservoir drawdown caused substantial slumping of the upstream face of No. 1 Bank and the displacing of many facing slabs. After investigations and reviews between 1973 and1983 threw doubt on the long-term reliability of the 1961 post tensioning of the concrete gravity section, a further round of substantial remedial works began. . In accord with then contemporary practice, these cables were not load monitorable and analysis indicated possible overturning if they failed. In addition, surveillance confirmed that uplift pressures were not completely dissipated by the foundation drainage system.

In 1985, further post tensioning comprising load monitorable cables was installed to meet current standards, including seismic loadings. The potential for seismic loadings also led to the post tensioning of the downstream retaining wall of the main embankment on the southern side of the river. A number of other parts of the dam were upgraded at the same time.

In April 1995 a remedial program was announced, to arrest on-going deformation of the embankment's core wall at 'the bend' near the southern end of the main earth embankment.

This followed expert advice that instability could increase over the next 10-15 years if the deformation was left unchecked.

During 1996 it was found that seepage of water around the junction between the earth embankment and the concrete gravity section was causing softening and loss of strength in the downstream earth embankment, resulting in movement of the concrete core wall. Investigations following detection of small movements of the corewall and embankment in August-September 1996 indicated reduced margins of safety. This led to the temporary lowering of the water level to achieve acceptable safety margins.

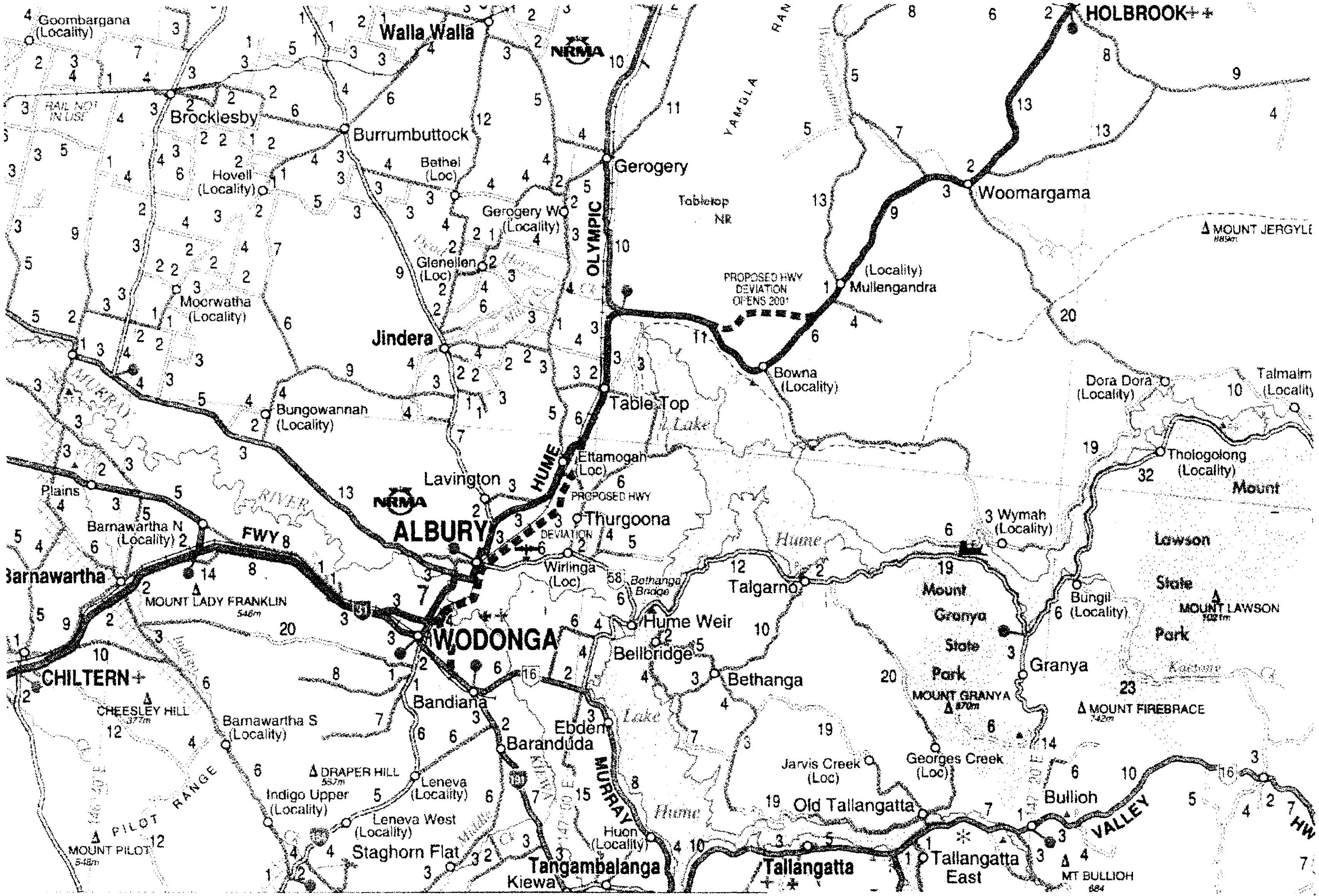
With the reservoir drawn down, key remedial works were accelerated and completed by November 1997, when operating restrictions were removed. A second phase of embankment works, designed to improve long-term integrity and resistance to extreme loads, was commenced in February 1999 and completed in mid 2001.

A third phase of the embankment program dealing with non-urgent issues will be completed in late 2002, at which time the embankments will satisfy contemporary design standards. The refurbishment program has also included overhaul of the electrical and control systems for the 29spillway gates, and the six storey gates have been replaced with new ones that can operate under all conditions.

Continuation of monitoring of the dam structure will include estimates of the impact of extreme floods on the Hume catchment. This world- leading research may result in further modifications to spillway capacity.

When these works are completed, Hume Dam will be given an architectural makeover with improvements to lighting, car parks, picnic areas, lookouts and general amenities for the thousands of annual visitors. The foundations for an outdoor museum will also be included, with individual display items to be added progressively as they are collected and refurbished.

Location Map



Plaquing Nomination Assessment Form

Item Name	**Hume Dam (Also – Hume Weir, Hume Reservoir)**
Location	16 km east of Albury on the Murray River Grid Reference: EA 027 037
Suburb/Nearest Town	Albury
State	New South Wales and Victoria
Other/Former Names	Hume Reservoir and Hume Weir
Local Govt. Area	
Owner	Murray-Darling Basin Commission (formerly River Murray Commission)
Current Use	Regulation of the Murray River, irrigation and electricity generation.
Former Use	Regulation of the Murray River and irrigation.
Assessed Significance	National
Statement of Significance	Hume Dam is of high significance under all categories i.e. with respect to its place in Australian history, historical association, creative and technical achievement, research potential, social, rarity and representativeness. Hume Dam is the major work of those authorised by one of the first cooperative inter-governmental agreements in Australia since federation, and ensured the development of large areas of NSW, Victoria, S.A. In 1915 the historic and pioneering River Murray Waters Agreement was signed by the governments of Australia, New South Wales, Victoria, and South Australia. Its purpose was the regulation of the river flow to ensure that each of the three riparian states received their agreed shares of the Murray's water. Without the River Murray works and Hume Dam in particular, vastly expanded agricultural and food production for both domestic and export purposes would not have been possible. The construction of Hume Dam was the largest engineering project between the two world wars and employed more than 1000 workers at the height of construction. When completed in 1936, it was one of the largest storage dams in the world. The dam is a major example of both concrete gravity and earth dam technology of the early 20th century. Management of the dam embodies the evolution of

Statement of Significance **(continued)**	techniques including surveillance that have developed over particularly the last 50 years. A substantial part of the workforce employed on the works in the 1950s and 60s, comprised European migrants from the Bonegilla Migrant Camp, a few kilometres into Victoria. The camp holds an important place in Australia's post-war migration program and both the camp and the Hume Dam project were significant in the assimilation of migrants. The camp itself is recognised as a heritage place and is on the Victorian Heritage Register, Register No: 1835. Construction workers were also domiciled in a camp located on the Victorian side nearer to the No. 1 bank. The remains of this camp are listed on the Victorian Inventory Register as site No: 8325-0002. From its basic design, through the upgrading and remedial works including its post-tensioning, Hume Dam provides evidence of the development of dam technology in Australia for both concrete gravity dams and earth dams with concrete core walls, and in dam safety management techniques. The movement of the town of Tallangatta to higher ground, resulting from the doubling of the storage volume in 1961, is perhaps the first example in Australia, outside the indigenous peoples, of a displaced community. The significance of Hume Dam lies in the main structure – the concrete gravity structure and No 1 Bank, Lake Hume, old Tallangatta and Bethanga Bridge (which has National Significance). Hume Dam has associations with at least four eminent engineers. • **Hugh McKinney** whose proposals for developing the irrigation and navigation potential of the River Murray formed the basis of the recommendations of the Corowa conference and the Inter-State Royal Commission of 1902. • **E M de Burgh** of the Department of Public Works, NSW; • **J S Dethridge** of the State Rivers and Water Supply Commission, Victoria; and • **G Stewart** of the Engineering and Water Supply Department of South Australia. De Burgh, Dethridge and Stewart produced a report on which the River Murray Waters Agreement was based and which resulted in the construction of Hume Dam and 13 weirs and locks on the lower Murray and Murrumbidgee rivers. The design of Hume was performed under de Burgh and Dethridge.

Hume Dam

Historical Notes:	The dam was named after Hamilton Hume, who in 1824 was the first explorer upstream of Albury. From the 1850s, development in the Murray Valley was initially dependent on transport along the river by paddle steamers with a period of prosperous river trade playing an important part in opening up the valley. With the completion of the NSW and Victorian railways to the border, river traffic rapidly declined. Fluctuations in river flow rendered navigation unreliable with the problem being exacerbated in the 1880s, as diversion of waters for irrigation developed. A major storage dam with a system of weirs and navigation locks along the river's length through South Australia, Victoria and NSW was discussed at a number of inter-colonial conferences. After federation, agreement was reached between the three states and the Commonwealth government on allocation and regulation of the waters of the Murray and the scope of necessary works. This agreement was embodied in the Commonwealth's River Murray Waters Act of 1915, which also provided for the establishment of the River Murray Commission (now the Murray-Darling Basin Commission), to administer the scheme. Construction began on Hume Dam in 1919. The government's vision was that the reliable supply of water would foster new settlements in the valley and bring confidence and prosperity to its population. It would also create 'a land fit for heroes' - the veterans returning from World War I. Although overshadowed by the Sydney Harbour Bridge, the more spectacular engineering achievement of the 1930s, Hume Dam at that time ranked among the largest storage dams in the world The concrete gravity structure was designed and constructed by the NSW Department of Public Works, while the State Rivers & Water Supply Commission of Victoria designed and constructed the 1.2km long earthfill dam with a concrete core wall. All of the work on construction was carried out by 'day labour' and at the height of construction, more than 1100 workers were employed, housed in two separate fully serviced towns, one on either side of the river. Interstate differences in wages awards gave rise to strikes by the workers, which were resolved during construction. The primary purpose of Hume Dam is to conserve water in periods of high flow for later release during periods of low flow. The principal use of the water is for irrigation but significant quantities of water are diverted from the River

Hume Dam

	Murray for domestic uses, industrial uses and to help supply entitlement flows to South Australia. Since its original construction, the dam has been enlarged, a hydro power station has been constructed and strengthening works have been undertaken, including post-tensioning. On 25 October, 2001 as the major item in its Centenary of Federation Plaquing Program, The Institution of Engineers, declared the engineering works of the River Murray in their entirety, a National Engineering Landmark, at a ceremony conducted at Hume Dam.
Designer:	Acting for the RMC, initial designs for Hume Dam were prepared by E M de Burgh Chief Engineer, Department of Public Works NSW and J S Dethridge Commissioner, State Rivers and Water Supply Commission, Victoria.
Maker/Builder:	Department of Public Works, NSW and State Rivers and Water Supply Commission, Victoria.

Year Started: 1919	**Year Completed: 1936, 1961**	**Circa:**

Physical Description:	A concrete gravity structure and four earth embankments. The gravity structure is 51 m high x 336 m long and incorporates a 222.5 m long spillway fitted with 29 x 7.3 m vertical lift gates, four irrigation outlet valves and a hydro power station comprising two 25 megawatt generators. The main earth embankment is 1.2 km long and has a concrete core wall as the impervious element. The dam has a storage capacity of 3,040,000 ML with a surface area of 20.2 sq. km, and its catchment area is 15 280 sq. km.
Physical Condition	This dam is carefully maintained in good physical condition, and its behaviour in service is constantly monitored. It has been strengthened on several occasions to take account of foundation uplift pressures, the effect of seepage on soil strengths and the possibility of earthquake loading.

Hume Dam

Modification Dates:	**1950-60s: Strengthening & doubling of storage volume** • completion of spillway crest; • installation of 29 x 7.3 m spillway gates and lifting superstructure; • anchoring of concrete gravity structure to its foundations (1961); • parapet wall along No 1 Bank; • rock weighting upstream face of No 1 Bank; • rock armouring of subsidiary banks; • repair of spillway dissipator bucket; • construction of hydro power station, **1985:** Re-anchoring of concrete gravity structure with cables that can have their tension checked at regular intervals. **1997:** Placement of additional earth at the toe of the bank near the bend in No 1 Bank to arrest movement. **1997-2002:** • grouting junction of the concrete corewall in No 1 Bank and the concrete gravity section; • construction of a weighting berm on the downstream face of No 1 Bank to strengthen the embankment; • installation of a flexible concrete wall (approximately 40 metres deep) immediately upstream of the corewall to provide a secondary seal; • construction of downstream weighting berms at the southern end of No 1 Bank and at No 2 Bank to provide additional strength against earthquake loadings.
SIGNIFICANCE **Historical Phase**	• Hume Dam is the major work of those authorised by the River Murray Waters Act 1915. • The dam is associated with the historic River Murray Agreement made between the Commonwealth Government and the State Governments of NSW, Victoria and SA.
Historical Association: **Historical Association:**	Hugh McKinney was a British civil engineer who, while attached to the Indian Irrigation Department, visited the Riverina area of Australia in 1879 and saw its potential for irrigation. He settled in Australia in 1879, joining the NSW Lyne Royal Commission on the Conservation of Water in 1884, and subsequently the NSW Department of Public Works. His proposals for developing the irrigation and navigation potential of the River Murray formed the basis of the recommendations of the Corowa conference and the Inter-State Royal Commission of 1902. These recommendations were largely embodied in the River Murray Waters Act, approved by the Commonwealth and three State Parliaments in 1915. The engineers E M de Burgh (NSW), J S Dethridge (Vic) and G Stewart (SA), were the principals in a conference set up as a result of an interstate Royal Commission into the regulation

Hume Dam	
(continued)	of the Murray waters. They produced a report on which the River Murray Waters Agreement was based and which resulted in the construction of the Hume Dam and 13 weirs and locks on the lower Murray and Murrumbidgee rivers. (Of the proposed 26 weirs and locks, 13 were built and other works – Yarrawonga Weir and the Murray Mouth barrages – were later substituted for the remainder.) E M de Burgh is one of the most famous engineers in the history of NSW. After an early career in bridge design resulting in a type of timber truss being known as a "de Burgh Truss", he became Chief Engineer for Harbours and Water Supply in NSW. He was responsible for the design and construction of Cordeaux, Avon and Nepean Dams, the Chichester Dam in the Hunter Valley, and the Umberumberka Scheme for Broken Hill. John S Dethridge became a Commissioner of the State Rivers & Water Supply Commission of Victoria in 1911. He designed the Dethridge Wheel which measures the quantity of water delivered to an irrigation area. He also designed the Mildura and Torrumbarry Weirs which could be pulled out of the river on rails during floods G Stewart was Engineer-in-Chief of the Engineer-in-Chief's Department in South Australia 1909-1918 which covers the period of the River Murray Waters Agreement.
Creative or Technical Achievement:	Hume Dam was the second concrete gravity dam in Australia to be anchored to its foundations with post-tensioned cables (in 1961), to ensure its stability against uplift pressure caused by seepage through its foundations. The first was the much smaller Sooley Dam in 1959. This technique became widely adopted.
Research Potential:	Provides opportunities for research of development of dam design and safety management in Australia over nearly 100 years.
Social:	The assurance of water supply and flood control for the valley have ensured its value to both urban and rural valley residents along some 2,000 km length of the Murray valley in Victoria, NSW and South Australia. The vista of the dam, the marine life in the reservoir and the biota of its surroundings, combined with its extensive areas of water make it an attractive and interesting place in inland NSW and Victoria. It is highly valued by the local community and by some 350,000 tourists who visit each year to enjoy water sports and fishing in the dam and camping in the storage environs.
Rarity:	Hume is uniquely associated with a cooperative effort of three States and the Commonwealth in reaching agreement on

Hume Dam

	regulation and sharing of the of the River Murray waters. This was followed by cooperative construction in which Victoria and NSW each built their halves of the dam. Deriving from the final agreement of all parties the River Murray Commission was born, which has developed into the Murray Darling Basin Commission, responsible for management of the largest and most important river basin in Australia.
Representativeness:	In relation to irrigation, the first major scheme in NSW was Burrinjuck Dam on the Murumbidgee River, constructed between 1907 and 1927. Hume and Wyangala Dams were the next. The importance of irrigation for increased economic production has remained high in Australia. Hume Dam itself has been enlarged and serves as an example of what can be achieved when water supplies can be relied upon.
Integrity/Intactness:	The original dam was designed for increased storage when required, by the installation of gates on the spillway. Later extensive remedial and upgrading works, whilst not foreseen when the dam was designed, are in keeping with the original structure and were necessary to ensure the structure's integrity and its ability to satisfy increasing demands.
References:	• ANCOLD (2000*). Dam Technology in Australia 1850-1999.* ISBN 0 957830 8 07 • ANCOLD (1990): *Register of Large Dams in Australia.* • Australian Heritage Commission Register of the National Estate Database (nd) Hume Dam and Pondage, Hume Weir (Vic). Database Number: 101592. Website: http://www.ahc.gov.au/ • Eagles J. (1998*)* Nomination for listing on the National Estate for the Institution of Engineers, Australia and the Australian National Committee on Large Dams. • Heritage Office & DUAP (1996) *Regional Histories of NSW.* Heritage Council: Sydney • IEAust. (1988) The engineers: 200 years at work for Australia. IEAust.: Sydney • Murray Darling Basin Commission (2001) *The engineering works of the River Murray.* Nomination for a National Engineering Landmark on the Centenary of Federation 2001. • Murray Darling Basin Commission. Website: http://www.mdbc.gov.au • River Murray Commission (c. 1986) *Hume Reservoir.* River Murray Commission: Canberra.

<table>
<tr><th colspan="5">Hume Dam</th></tr>
<tr><td>Listings</td><td>Name:

Register of the National Estate

NSW State Heritage Register

Victorian State heritage Register

National Trust Of Australia (NSW)

National Trust of Australia (Victoria)</td><td>Title:

Hume Dam and Pondage</td><td>Number:

101592

Not Listed

Not Listed

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Not Listed</td><td>Date:</td></tr>
<tr><td>Image/s:</td><td colspan="4">• Hume Dam: General arrangement 1975.
• Images

– Concrete core wall under construction
– Gravity section under construction
– Gravity section
– Gate lifting superstructure
– New outlet valve and power station
– Southern downstream retaining wall and main embankment
– Original irrigation valves</td></tr>
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Proposed wording of the information plaque

NATIONAL ENGINEERING LANDMARK

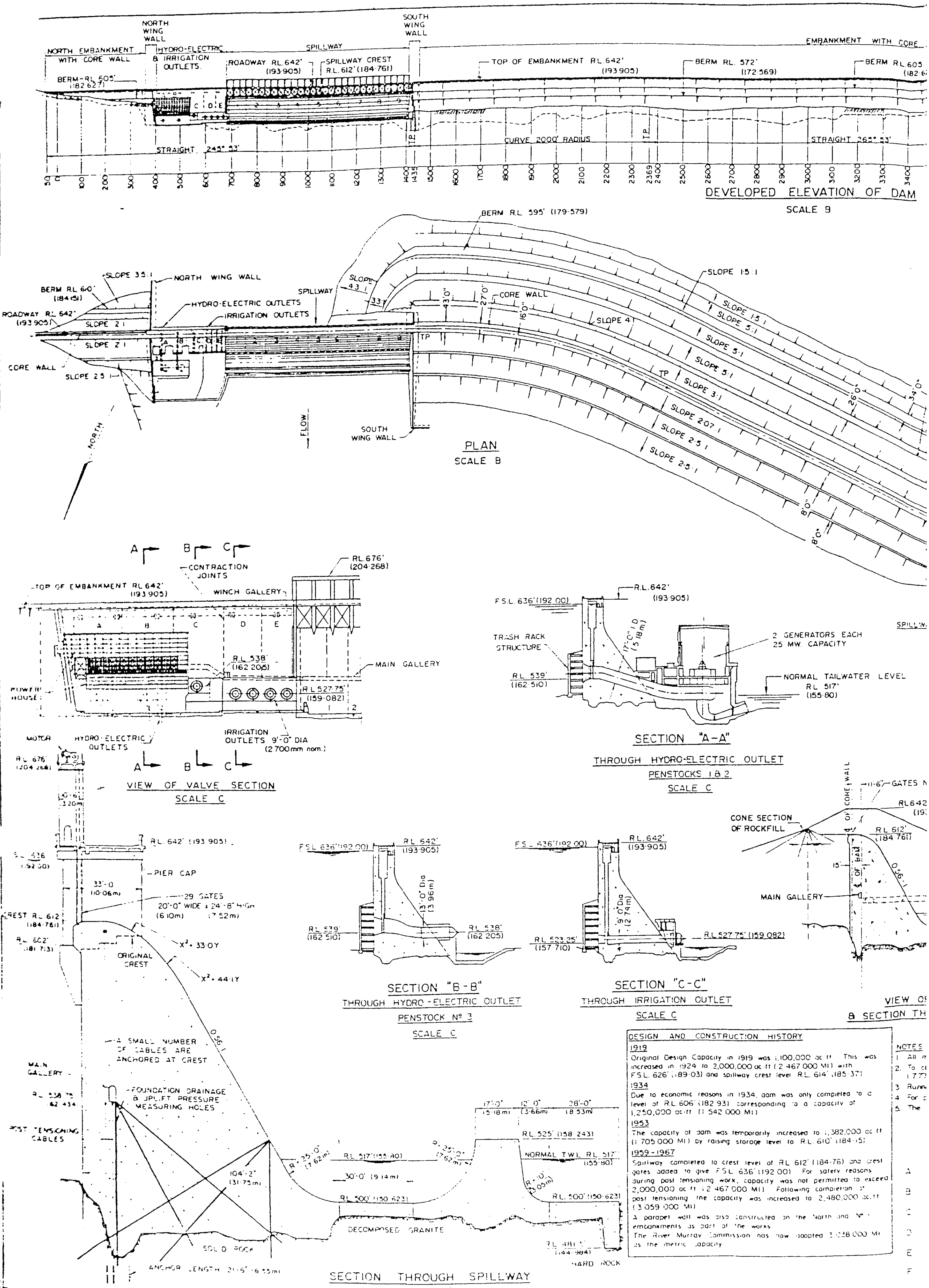
Hume Dam

The design of Hume Dam, which was the major work authorised by the River Murray Waters Act (1915), was directed by engineers E M de Burgh (NSW) and J S Dethridge (Vic). The dam supplies irrigation, town and stock water to the Murray Valley, mitigates floods, generates power and enabled vastly expanded agricultural and food production. When commissioned in 1938, it was one of the largest dams in the world. Its storage capacity was doubled to 3000 million cubic metres in 1961. In its basic design and subsequent upgrading, Hume provides evidence of the development of dam technology in Australia. Work in the 1950s-60s involved a large number of post-war migrants, the relocation of Tallangatta township and the raising of Bethanga Bridge.

The Institution of Engineers, Australia,

Murray-Darling Basin Commission and

Department of Land and Water Conservation NSW. 2002



DESIGN AND CONSTRUCTION HISTORY

1919

Original Design Capacity in 1919 was 1,100,000 ac ft. This was increased in 1924 to 2,000,000 ac ft (2 467 000 Ml) with F.S.L. 626' (189·03) and spillway crest level R.L. 614' (185·37)

1934

Due to economic reasons in 1934, dam was only completed to a level of R.L. 606' (182·93) corresponding to a capacity of 1,250,000 ac ft (1 542 000 Ml)

1953

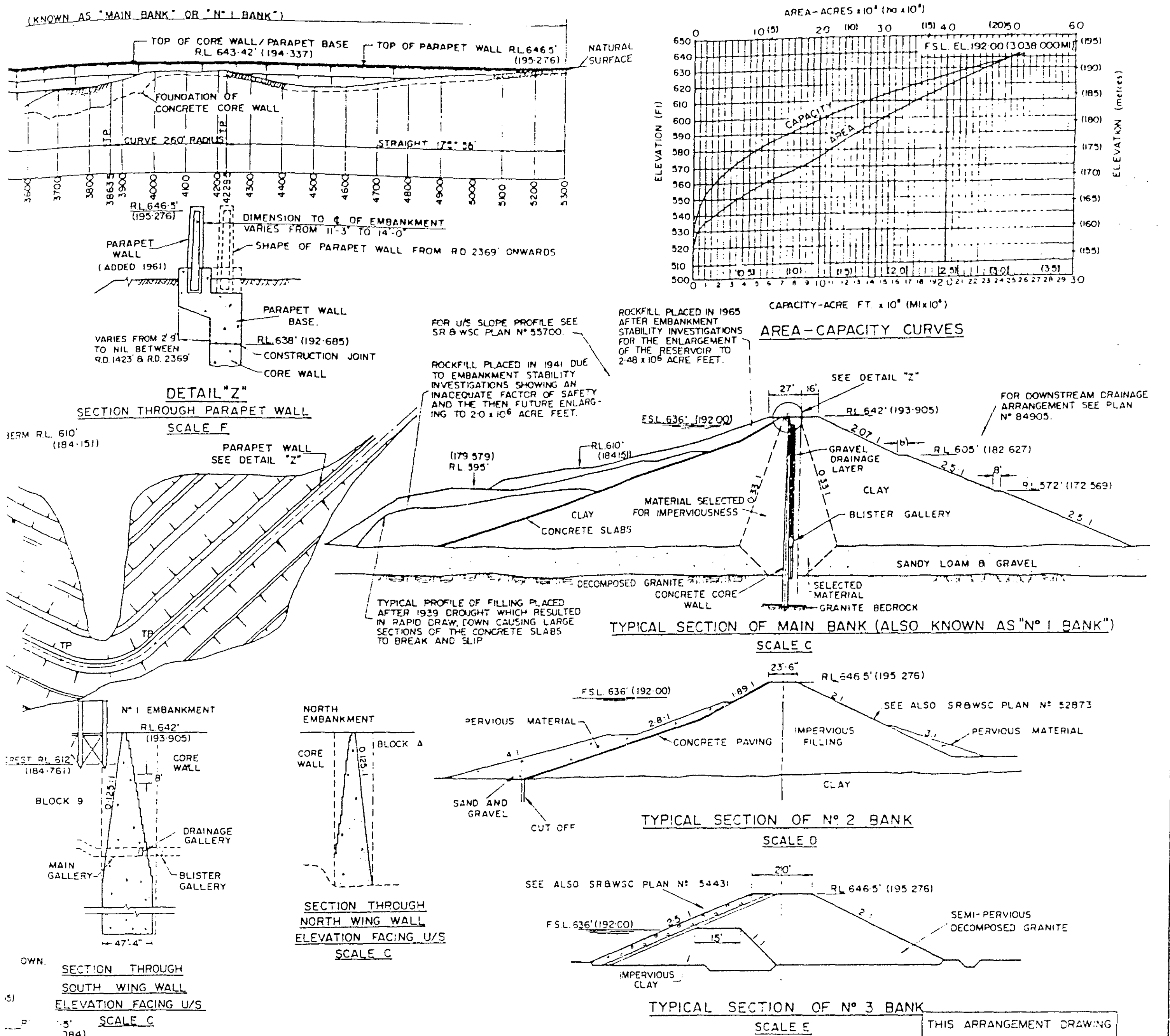
The capacity of dam was temporarily increased to 1,382,000 ac ft (1 705 000 Ml) by raising storage level to R.L. 610' (184·15)

1959 - 1967

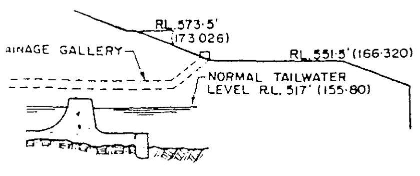
Spillway completed to crest level of RL 612' (184·76) and crest gates added to give F.S.L. 636' (192·00). For safety reasons during post tensioning work, capacity was not permitted to exceed 2,000,000 ac ft (2 467 000 Ml). Following completion of post tensioning the capacity was increased to 2,480,000 ac ft (3 059 000 Ml)

A parapet wall was also constructed on the North and No 1 embankments as part of the works.

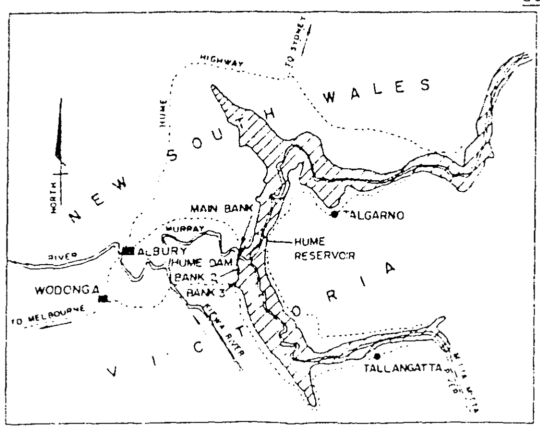
The River Murray Commission has now adopted 3 038 000 Ml as the metric capacity



THIS ARRANGEMENT DRAWING WAS COMPILED IN 1975.



TH WING WALL
UGH SPILLWAY & DISSIPATOR
CALE C



LOCALITY PLAN
SCALE A

...vels are to Australian Height Datum (A.H.D.).
...H.D. at Hume convert imperial levels to metric and deduct ...L. 642' = 193·905).
...distances are in feet.
...cal purposes, metric levels should be rounded to two decimal places.
...S...ply Level has been rounded down from EL.192·076 to EL.192·00.

SCALES

0	5	10	15	MILES
0	200	400	600	FEET
0	60	120	180	FEET
0	50	100	150	FEET
0	20	40	60	FEET
0	4	8	12	FEET

REFERENCES		REVISIONS				
PLAN No	TITLE	No	DATE	DESCRIPTION	APP'D	FILMED
93662	Cross sections of spillway					
93663	Cross sections of valve section					
123164	Spillway gates lifting machinery					
55700	Recommended Profile					
55484	Precast parapet wall					
84905	Crest & D/S drainage					
52874B	Supplementary bank No 3					
123167	Hume Reservoir augmentation 6A					
84904	Cone end-additional rockfill					
123165	Superstructure for spillway gates					
77246	Capacity-Area curve					
93661	Foundation levels of dam of spillway section					
52873	Supplementary bank 2AB					
123166	Arrgt of trash racks					
54626	Spillway crest-RL 612·8 adopted					
54431	Supplem. bank No 3-toe drain					
53226A	Spillway gates					
84906	South wing wall					
93665	Embankment					

STATE RIVERS & WATER SUPPLY COMMISSION

RIVER MURRAY COMMISSION WORKS.

RIVER MURRAY COMMISSION

CHIEF DESIGNING ENGINEER 20.11.75

CHIEF ENGINEER MAJOR WORKS

COMMISSIONER

PRESIDENT — COMMISSIONER REPRESENTING S.A. — COMMISSIONER REPRESENTING N.S.W. — COMMISSIONER REPRESENTING VIC.

M/FILM CATEGORY — M/FILM OPERATOR

HUME DAM

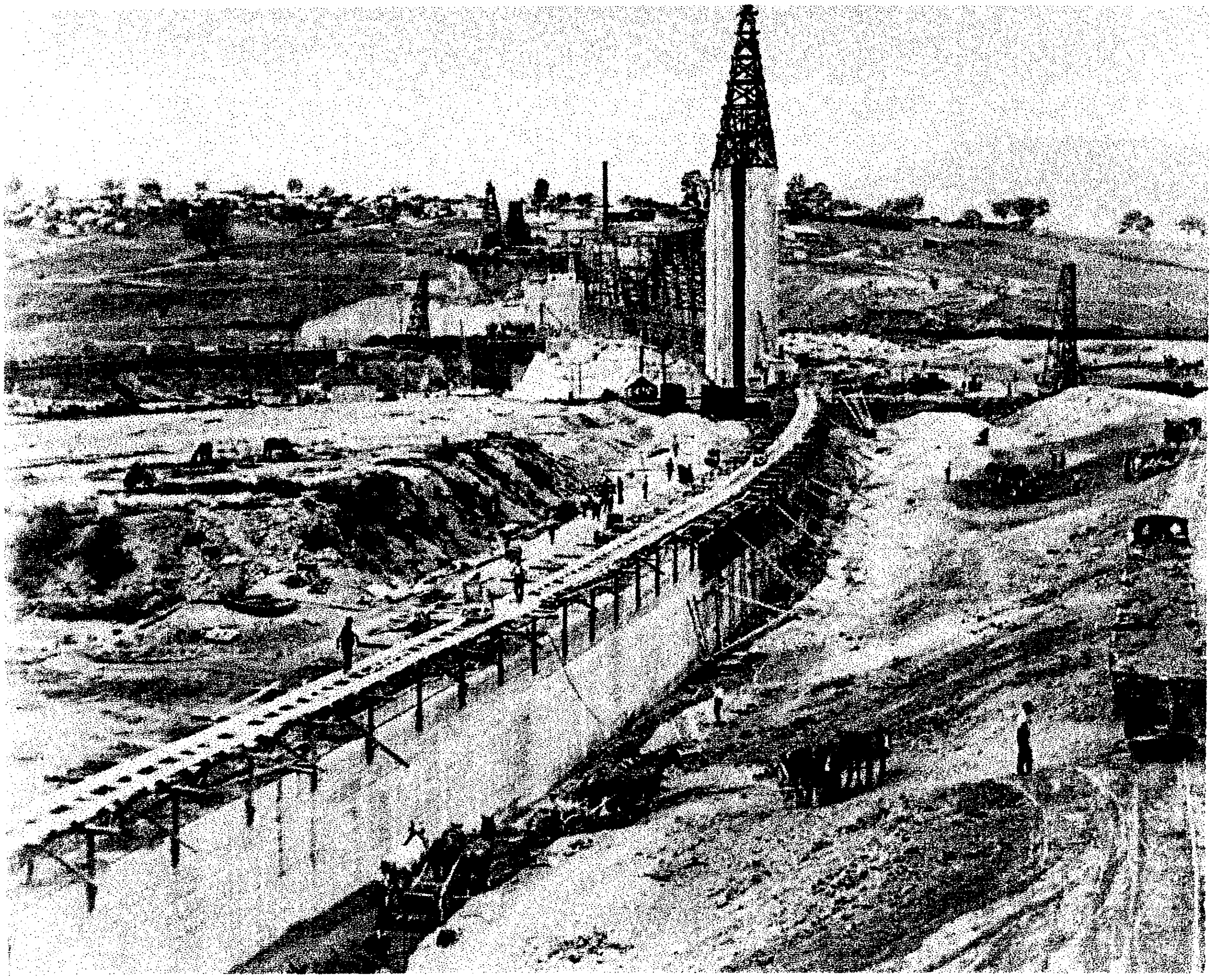
GENERAL ARRANGEMENT

S.R.& W.S.C. 1975 PLAN N° 93660

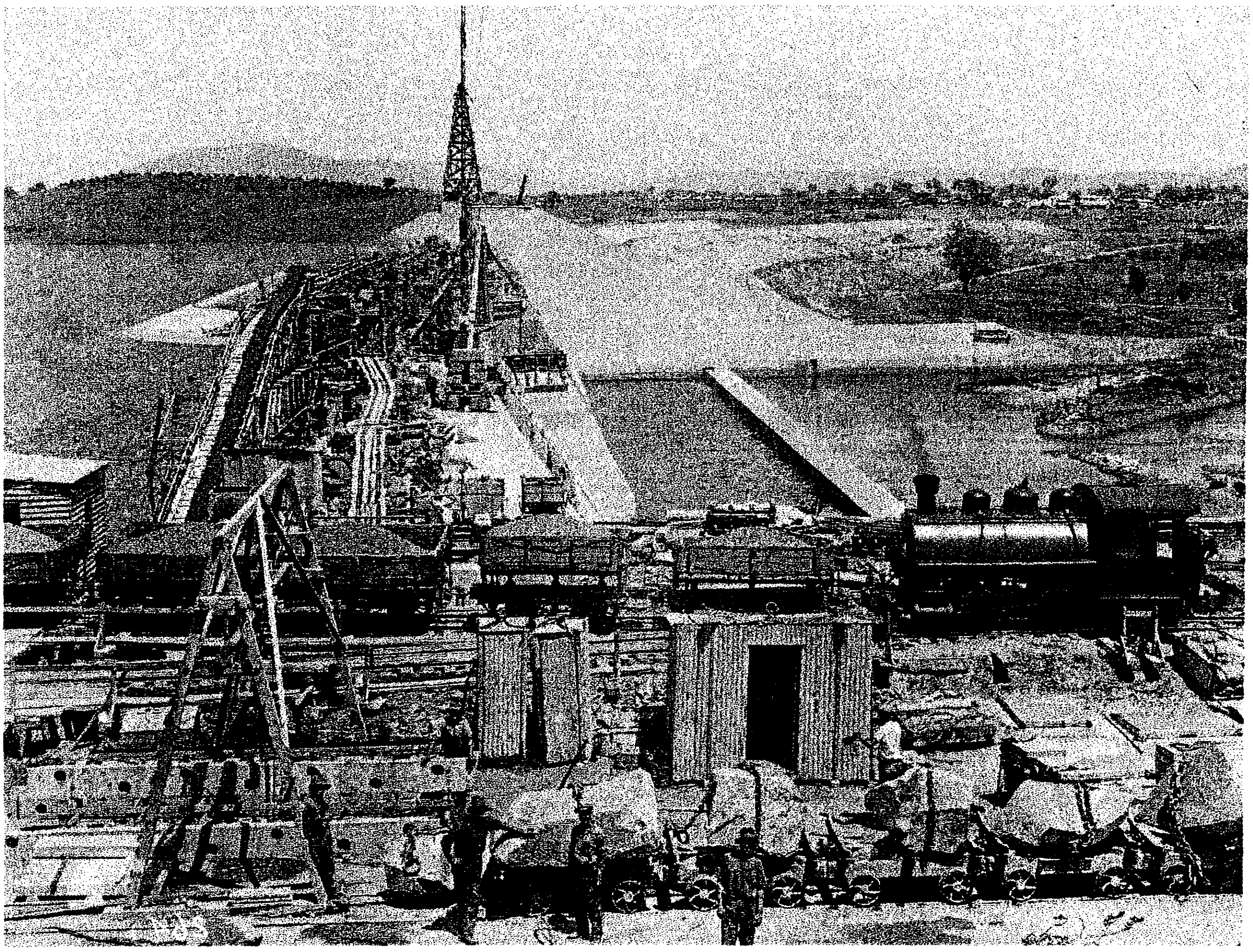
CORR N° 75/4679

Figure 2

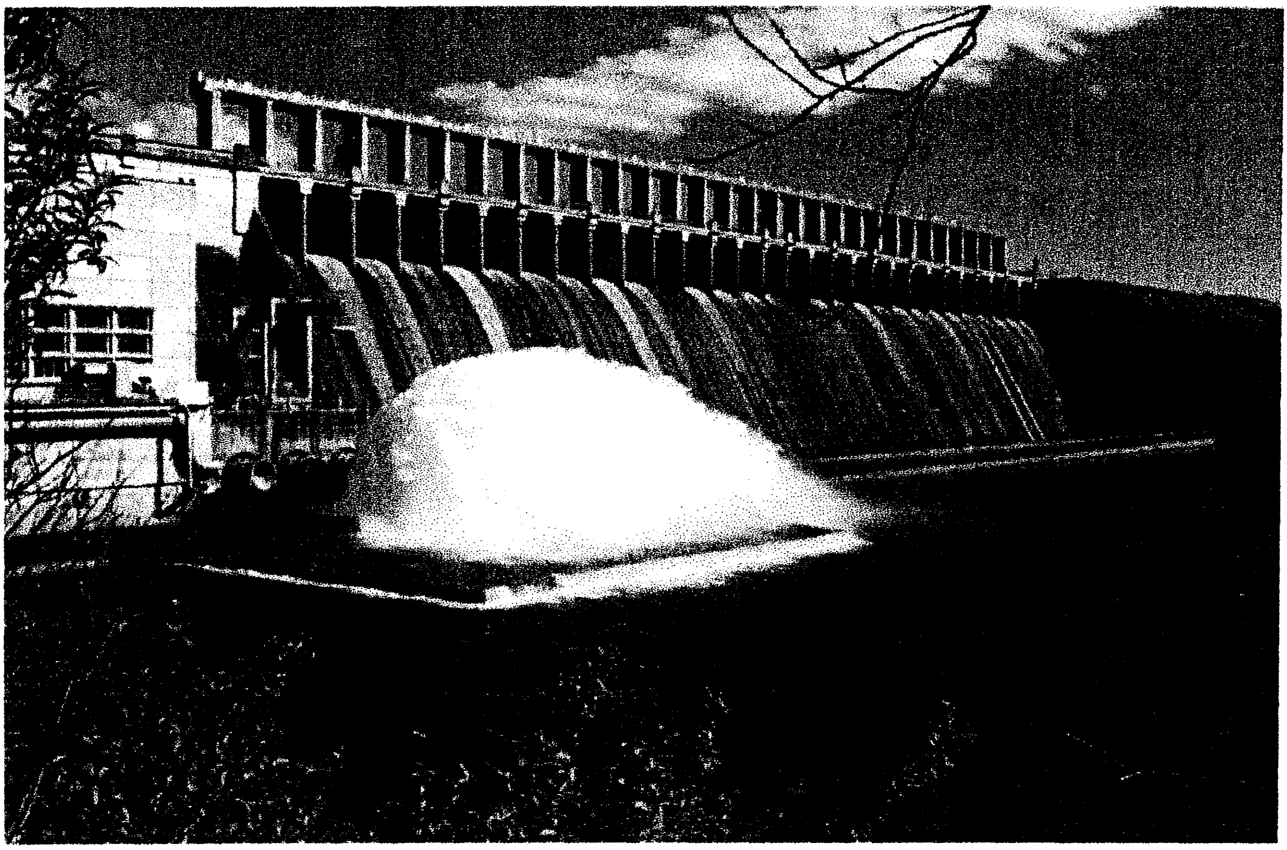
Appendices - images



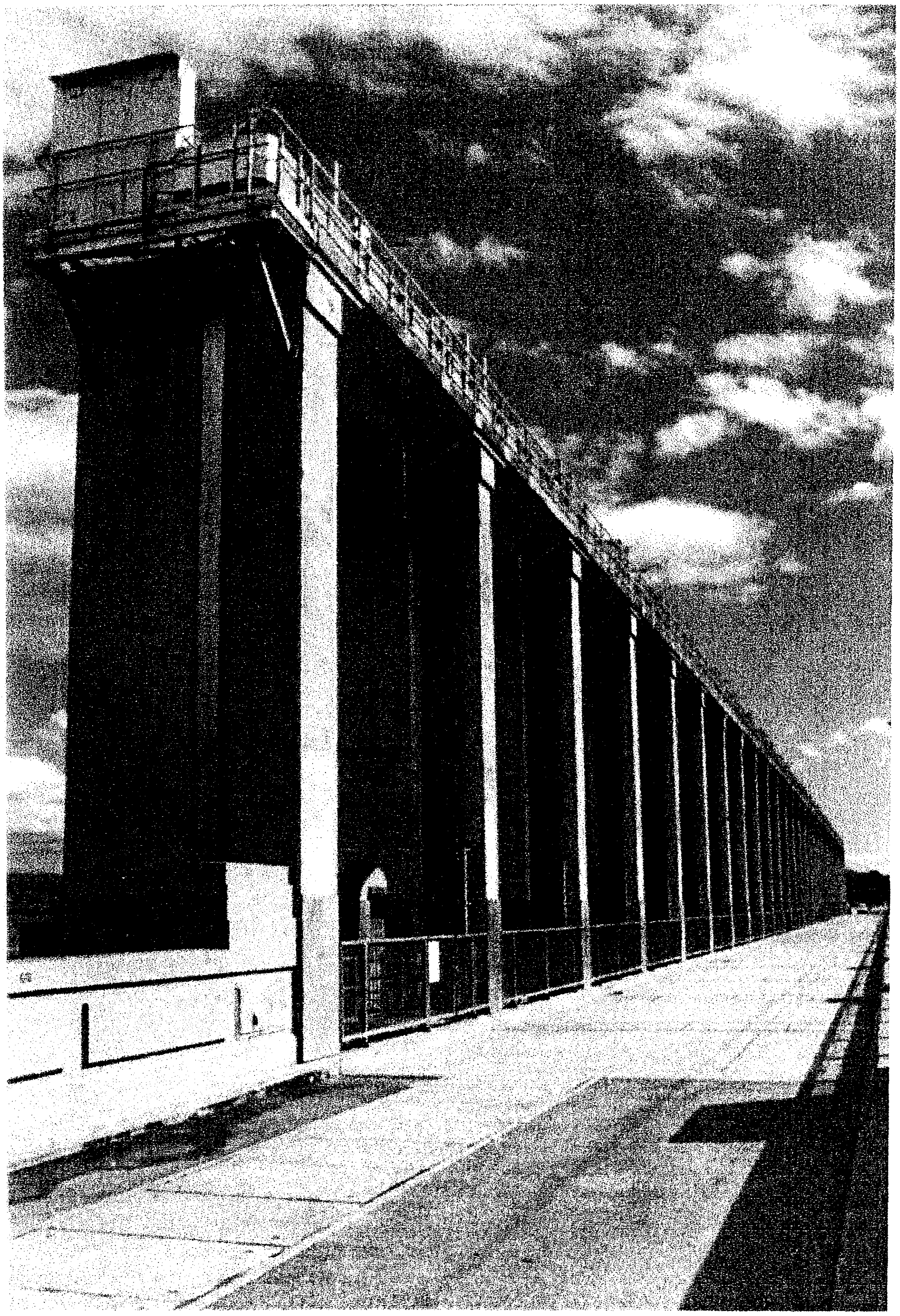
Caption: Core wall under construction



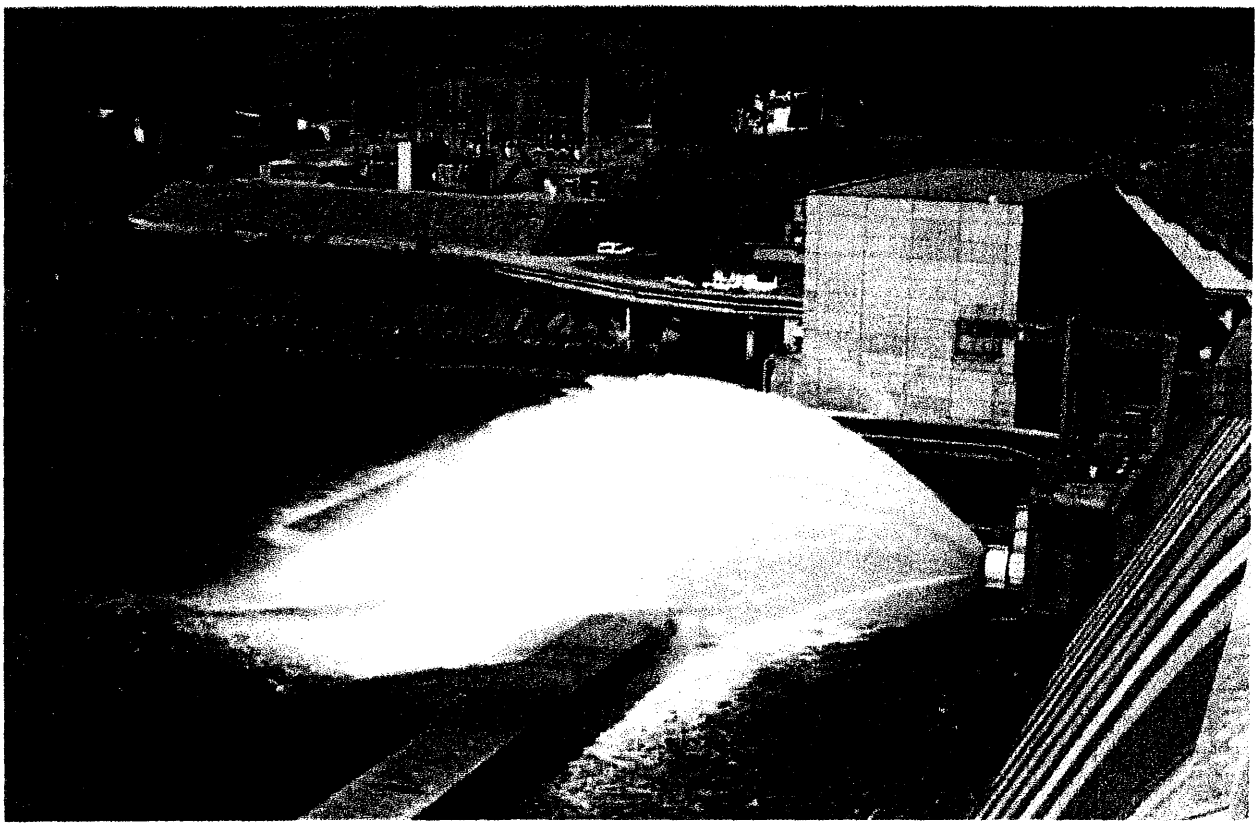
Caption: Gravity section under construction



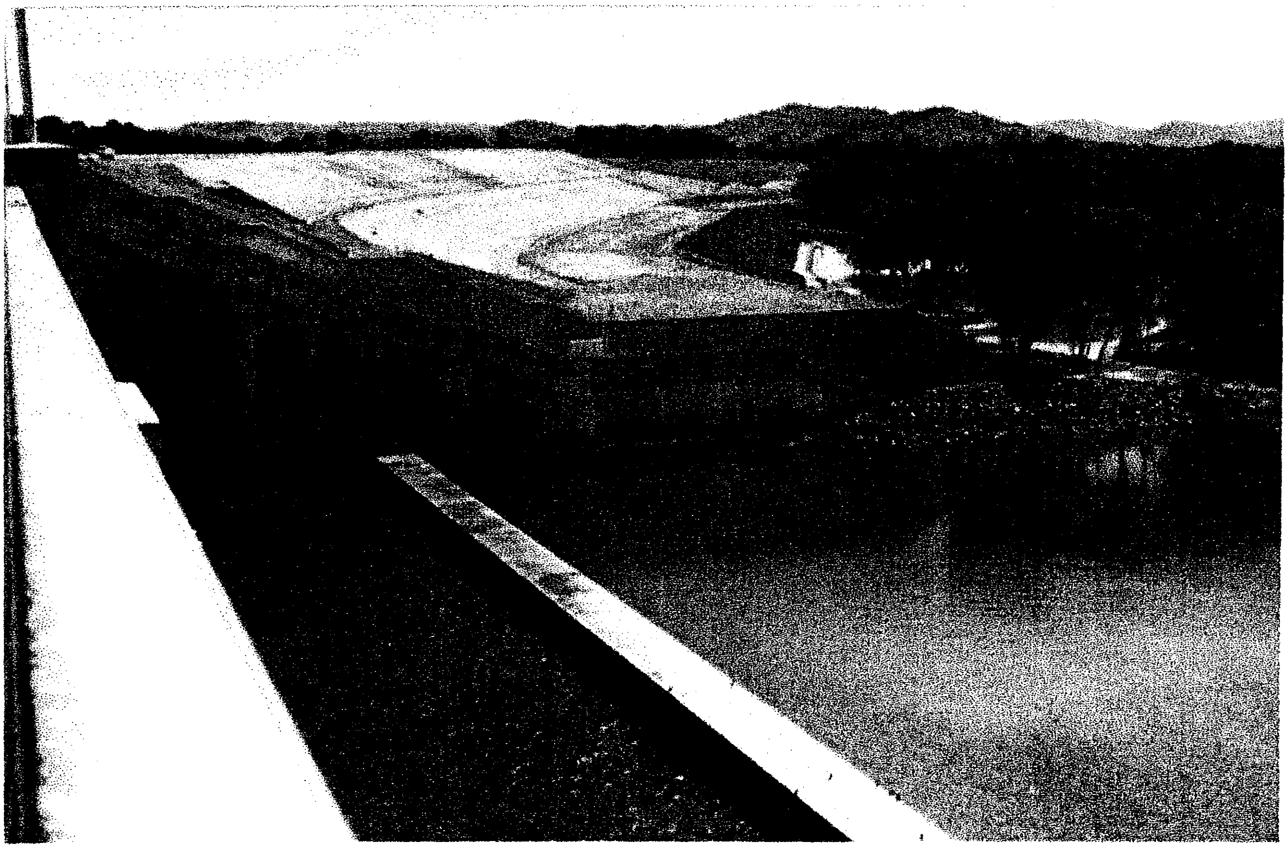
Caption: Gravity section



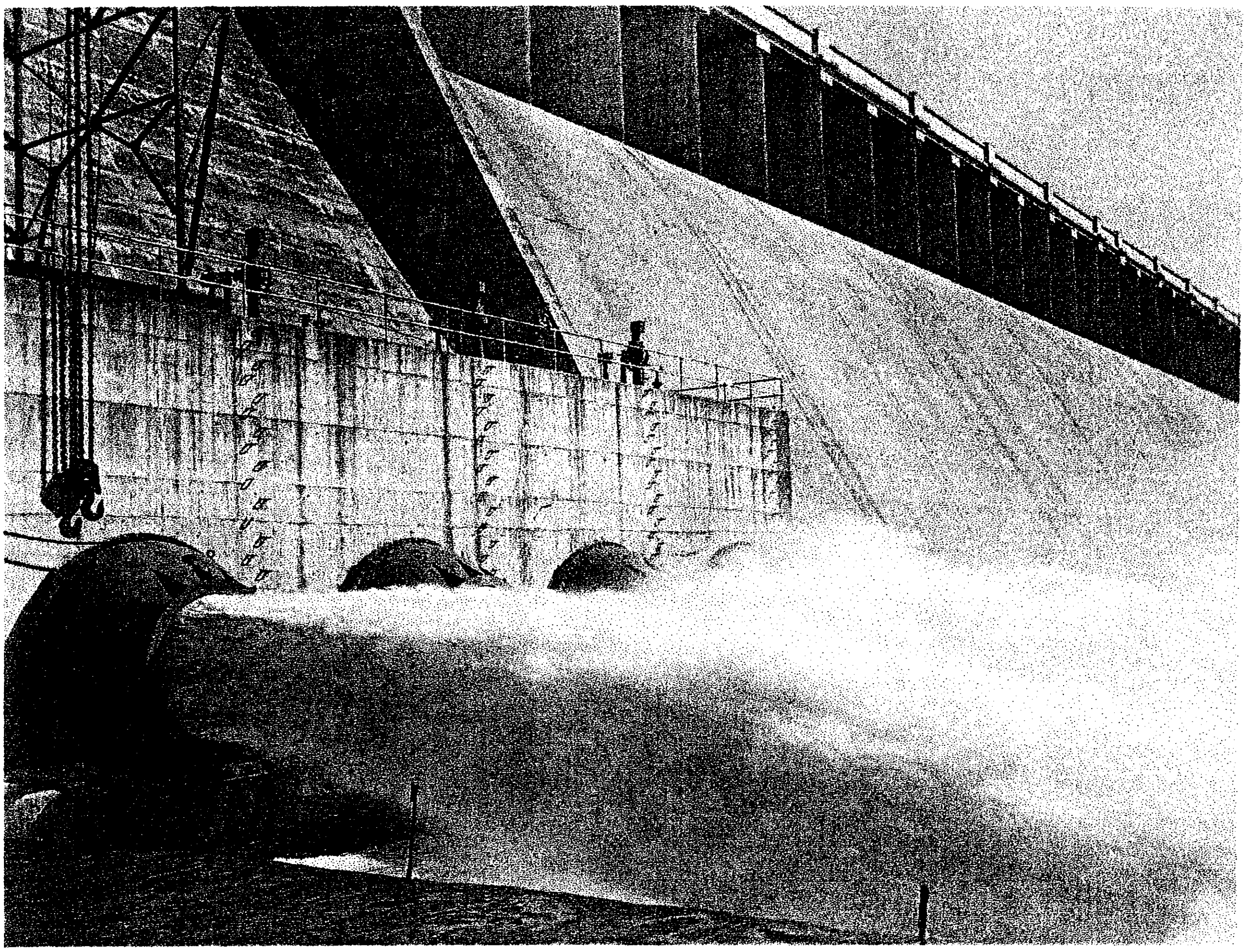
Caption: Gate lifting superstructure



Caption: New outlet valve and power station



Caption: Southern downstream retaining wall and main embankment



Caption: Original irrigation valves

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